Recurrent Pediatric Headaches: Behavioral Concepts and Interventions

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Abstract

Recurrent pediatric headaches are increasingly understood to be a function of both respondent and operant processes. In particular, the environment is thought to elicit internal autonomic instability and to evoke external maladaptive pain behavior. While medical interventions often provide an appropriate first line treatment, behavioral interventions can provide an important adjunct to medical intervention and in some cases provide valuable alternative sources of relief. This article reviews the prevalence, types, and functional impairments associated with recurrent pediatric headaches and the behavioral concepts that help explain their etiology. The article also reviews the substantial empirical research that supports the efficacy of behavioral interventions. These include teaching children to control autonomic reactivity through relaxation or biofeedback and then arranging for an environment that reinforces use of these tools. The article concludes with a discussion of future directions for research in biofeedback, including the application of behavioral concepts and interventions to other chronic health related problems in children.
Key Words: headaches, biofeedback, migraine, pediatric, behavioral interventions.

Recurrent pediatric headaches represent a clinically significant health problem for many children and youth. Over a third of all adolescents in the United States complain about headaches in general (US Dept Health and Human Service, 2003), and headaches are among the most common clinical problems encountered in schools (Peterson, Bergstrom & Brulin, 2003; Schneider, Friedman, & Fisher, 1995). Although prevalence rates vary, actual recurrent headaches appear in about 10% of all preadolescent children and up to 15% of all adolescents (Hershey, 2005; Mortimer, Kay, & Jaron, 1992; Newacheck & Taylor, 1992). In general, recurrent pediatric headaches (a) typically first appear around 6-7 years of age, (b) become more prevalent with age, (c) present more frequently in preteen boys than preteen girls, and (d) present more frequently in adolescent girls than adolescent boys (Abu-Arafeh & Russell, 1994; McGrath & Hillier, 2001).

Pediatric headaches are particularly problematic because they can result in increased health care utilization (Stang, Osterhaus, & Celentano, 1994) and can result in prolonged absences from school (Cannon & Compton, 1980; Stang & Osterhaus, 1992). Empirical studies have found significant morbidity in terms of lost time at school (e.g., Lee & Olness, 1996). For example, children who experience recurrent headaches have been found to miss 2.5 times more school days than children who are headache free (Abu-Arefeh & Russell, 1994). In addition, children and youth with recurrent headaches are at risk for more social withdrawal, impaired school performance, and decreased ability to cope with demands in the classroom (e.g., Poznanski, 1982; Reynolds, 1991; Shaw, 1988). Overall, children with recurrent headaches have been found to experience impairment in school and social functioning comparable to other children with significant chronic diseases (e.g., Powers, Patton, Hommel, & Hershey, 2003).

Recurrent headaches are characterized by repeated painful episodes experienced across several months that occur in the absence of a well-defined medical cause. The most common recurrent headaches in children are migraine headaches (characterized by sharp, throbbing, moderate to severe pain), and tension headaches (characterized by dull, mild to moderate diffuse pain). Although the most common

differentiation between the two types of recurrent headaches involves intensity and frequency (i.e., migraine headaches are typically infrequent and intense; tension headaches are typically frequent and moderate), in practice, there is a good deal of overlap across these two types of recurrent headaches. Increasingly headaches are being viewed as representing different points on a continuum of severity rather than distinct diagnostic categories (Rossi, Cortinovis, Menegazzo, Brunelli, Bossi & Macchi, 20010; Turkdogan, Cagirici, Soylemez, Haydar, Bilge, & Turk, 2006).

The most significant problems associated with headaches in general involve the potential presence of organic pathology. Significant symptoms can include progressive pain, intellectual decline, personality changes, or increased clumsiness. However, even without these symptoms, recurrent headache activity should always be evaluated by a physician to rule out the presence of disease processes. Causes of headaches can include recent infections (e.g., sinus), increased intracranial pressure from excessive fluid or swelling, solid tumors, diseases such as hypertension, or dental problems (Dalessio & Silberstein, 2001,). Once an organic cause has been ruled out, the diagnosis of migraine or tension headache can be appropriate.

Respondent Conceptualizations

Sadly, an outdated disease model still persists in which headache pain in the absence of organic pathology is often considered to be evidence of psychological "disease" (i.e., psychopathology or malingering). Although this model relies on an inadequate, dated and restrictive disease dichotomy (Forsyth & Farrell, 1999), it continues to be promoted, with virtually no acknowledgement of the role of the environment in eliciting or maintaining pain behavior in children or the role of behavioral strategies for managing recurrent headache syndromes (e.g., Molofsky, 1998). However, there is increasing evidence that the environment and genetics play an important interactive role in the etiology of recurrent headaches. Individuals with recurrent headaches are now thought to have a genetic predisposition for dysregulation of the central pain modulating pathways or descending pain control systems (Lewis, 2004). In this model, the genetically predisposed child experiences a reduced threshold to internal or external environmental stimuli which elicit a cascade of autonomic reactivity (Lewis, 2004; Rothner, 1995). The sustained autonomic reactivity is what is thought leads to pain. Common stimuli that can elicit reactivity and subsequent headache pain in children can include exercise, caffeine, alcohol, fatigue, academic demands, and emotional distress (e.g., Larsson & Zaluha, 2003; Singer, 1994). Indeed, half of all high school students who report headaches describe stress and tension as important factors (Schneider et al., 1995). Eliciting stimuli, however, might also include events commonly considered to be positive, such as going to an amusement park, attending a birthday party, physical exercise, or even sleeping in on weekends. In this model, recurrent headaches are not evidence of psychopathology or malingering. Neither are the headaches caused by "stressful" events (since not everyone gets headaches under these conditions), nor are the headaches caused by the child's reactivity (since not every stressful event leads directly to a headache). Instead, both the child's autonomic reactivity and the stimuli that elicit it are relevant in understanding at least part of the etiology of recurrent headaches (e.g., Zeltzer, Barr, McGrath, & Schechter, 1992).

Operant Conceptualizations

In addition to these respondent aspects of recurrent headaches, learned responses to pain can play an important role in understanding recurrent pain (e.g., Fordyce, 1976; Rachlin, 1985). When children experience recurrent headaches, they may stay home from school, lie down, massage the temples, close the shades, take medication, demand quiet, and/or sleep. In doing so, they learn that these behaviors typically provide some pain relief. As a result, children are much more likely to engage in these behaviors again, precisely because these behaviors produce reinforcement in the form of short term pain reduction. In addition, maintenance of pain behavior may be enhanced through imitation of adults with

recurrent pain symptoms (e.g., Fordyce & Steger, 1979), through parental attention and solicitous responses to pain behavior (e.g., Peterson & Palermo, 2004), and through the absence of reinforcement for well-behavior (Allen & Mathews, 1998). Unfortunately, these common pain behaviors rarely provide long term pain relief and often interfere with adaptive functioning at school and at home. In addition, children may learn that some pain behaviors allow them to escape unpleasant demands (e.g., chores) or unpleasant experiences (e.g., tests) or allow them increased attention from parents, nurses, or peers. It is not difficult to see how these types of consequences could also reinforce behaviors that interfere with adaptive functioning at home and at school. However, it is the experience of pain relief that is understood to be the primary factor in determining which behaviors children learn to use when they are in pain.

Medical Interventions

Perhaps not surprisingly, the most frequent point of intervention with recurrent headaches involves not behavior management, but medical management. Indeed, a physician is the most appropriate professional to initially assess and treat a child presenting with recurrent headaches. Common pharmacologic treatments include both abortive and prophylactic agents. Because most simple analgesics and nonsteroidal anti-inflammatories have few side effects, these abortive medications are the first line of treatment for children with recurrent headaches (Singer, 1994). Prophylactic medications do have a higher likelihood of side effects such as nausea, sedateness, fatigue, and light-headedness, but there are no studies indicating the extent to which these might impact daily functioning and/or school performance in children. A recent review of pharmacologic treatment of childhood headache has shown that no abortive or prophylactic agents have been proved effective in controlled studies with children (Pakalnis, 2001). As a result, pharmacological management of headache activity is highly individualized and the effectiveness and possible side effects should be closely monitored by the child's physician. The general consensus is that the use of daily prophylactics or prescription abortives is not desirable for children, especially given that there are behavioral pain management strategies that are viable alternatives (Pakalnis, 2001; Singer, 1994).

Behavioral Interventions

Behavior interventions have focused on teaching children to control the autonomic reactivity typically elicited by the environment. Empirical research has demonstrated that individuals can, in fact, gain volitional control over numerous autonomic nervous system functions via "self-regulation training." This typically involves teaching (a) simple relaxation procedures, (b) teaching biofeedback, or (c) teaching both (Allen, 2004). Sufficient evidence now exists from treatment outcome studies to conclude that both approaches are well-established as effective treatments for recurrent headaches in children (Holden, Deichmann, & Levy, 1999). The actual self-regulation skills that are taught can vary widely depending upon how quickly the child learns the skills, the cognitive capabilities of the child, and resources available. Relaxation training might involve progressive muscle relaxation, guided imagery, diaphragmatic breathing, or some combination of them all (see Cautela & Groden, 1978). In progressive muscle relaxation, children practice tensing and relaxing different muscle groups to help them learn to identify when their body is tense and how to relax it. In guided imagery, children are taught to imagine a previous experience or pleasant event to help them relax and distract them from the pain. Diaphragmatic breathing involves teaching children to use slow, deep breathing, concentrating on breathing with the diaphragm (e.g., Gevirtz & Schwartz, 2003). These type of approaches have been successfully implemented by school nurses (e.g., Larsson & Carlsson, 1996), but are labor intensive and may not be well received by nurses (e.g., Fichtel & Larsson, 2004) or by students (Schneider, et al., 1995), who often go to the nurses office to rest rather than to learn self regulation skills.

Biofeedback often involves learning to increase hand temperature (thermal biofeedback) as a means of producing autonomic stability. Investigations have repeatedly demonstrated that thermal

biofeedback is an effective, efficient treatment for pediatric headache (Duckro & Cantwell-Simmons, 1989; Hermann, Kim, & Blanchard, 1995). In these studies, more than two thirds of the children experience a significant 50% reduction in headache activity with biofeedback (Hermann & Blanchard, 2002). Investigations have also demonstrated that thermal biofeedback can be efficiently and effectively applied in as few as three-four visits, (Allen & McKeen, 1991; Scharff, Marcus, Masek, 2002), in a primary care clinic (Allen, Elliot, & Arndorfer, 2002), and with those who experience tension headaches (Arndorfer & Allen, 2001).

The success of thermal biofeedback may lie, in part, in the immediacy of the feedback, a feature known to be important when learning new behaviors. The feedback itself may also prove particularly salient for children who, in an age of constantly advancing technology, are drawn to computers. Children sit in front of a computer screen, with sensors taped to the skin, and watch as the computer displays moment-to-moment changes in autonomic activity. In the case of thermal biofeedback, the information provided describes changes in hand temperature, an indirect measure of peripheral blood flow. In an era in which computer games are an established part of the culture, perhaps the computer delivered feedback is a more salient reinforcer. Indeed, some researchers have argued that children learning via biofeedback are more enthusiastic and less skeptical than adults and that they learn more quickly than adults (Attanasio, Andrasik, Burke, Blake, Kabela, McCarran, 1985; Culbert, Kajander, Reaney, 1996). Finally, the availability of inexpensive home temperature trainers make thermal biofeedback portable and easily used within a variety of settings.

Unfortunately, the environment does not always support use of these self-regulation skills. Although typical pain responses provide no significant reductions in long-term pain frequency, intensity or duration (Allen & Mathews, 1998), these responses do often provide some immediate short-term relief. This immediate relief is a powerful reinforcer, so children are not easily persuaded to attempt alternative strategies such as biofeedback or relaxation, which provide more delayed benefits. In addition, parents and teachers often encourage typical responses to headache pain (e.g., lie down, sleep), precisely because it provides the child with some relief, if only for a short time. One of the challenges is to create an environment that reinforces the child for learning and then using alternative strategies such as biofeedback or relaxation.

Not surprisingly, research has shown that creating an environment that supports alternative ways of responding to pain can be an important part of enhancing treatment outcome (Allen & McKeen, 1991; Allen & Shriver, 1998; McGrath & Feldman, 1986; McMahon, Harper, & Cruikshank, 1990; Sander, et al., 1989). A supportive environment would include asking the caretaker to minimize their responses to pain behavior, to increase their prompting and reinforcement of the child's use of self-regulation skills, and to reduce their own efforts to assist with pain management. In addition, the caregiver can encourage active participation in normal activities and work to prevent the use of former palliative techniques. Previous research has shown that parents who were asked to follow these types of recommendations were found to have children who exhibited more adaptive and independent coping (Allen & Shriver, 1998). That is, parents who reinforced attending school, completing school work, and participating in daily activities had children who managed headaches better, regardless of how much the children practiced the self-regulation skills, than parents who did not follow through with or were not given the same recommendations. Their children tended to exhibit less adaptive coping, regardless of how much they practice self-regulation strategies. It is important to note, however, that some caregivers may find adherence to these types of recommendations to be troublesome. Guidelines that dissuade adults from helping with pain management or that require children to stay active may seem harsh and dispassionate. Children may benefit if they are encouraged and supported in their use of alternative approaches to pain management, but adherence has not been found to be a necessary component of good treatment.

Future Directions

Recurrent pediatric headaches represent a significant health problem. While behavioral interventions have been demonstrated to offer clinically significant benefits, there are important questions that remain. For example, it is unclear whether these behavioral interventions represent cost effective alternatives to traditional medical interventions, since few direct comparisons of behavioral and pharmacological interventions with children have been conducted (e.g., Sartory, Muller, Metsch, & Pothmann, 1998). In addition, while a genetic predisposition for autonomic instability would suggest the potential for lifelong struggles with stress-related disorders, it is unclear whether learning behavioral self-regulation skills as a child has benefits into adulthood. Indeed, there have been no follow-up studies evaluating the long-term benefits of learning biofeedback or any other self-regulation skills for managing headaches. This is important because in spite of clinical evidence that there is some spontaneous remission of recurrent headaches with age, there are no clear indicators of who may become pain free and who will continue to suffer. Future studies might also explore the ease with which biofeedback and related behavioral interventions can be implemented in primary care settings and school-based clinics where rural and underserved populations may have more access to behavioral health care. Moreover, biofeedback interventions typically require daily home practice of skills learned in clinic; however, it is not clear to what extent home practice is critical to headache relief.

Interestingly, biofeedback continues to be an important avenue for the transfer of research-based behavioral technology into applied settings. Although applications of biofeedback with children have focused almost exclusively on treatment of headaches, there have been numerous attempts at using biofeedback to treat other types of problems in pediatric health. These attempts have included efforts at managing pain associated with sickle cell crises (Cozzi, Tyron, & Sedlacek, 1987), juvenile rheumatoid arthritis (Lavigne, Ross, Berry, Hayford & Pachman, 1992), and recurrent abdominal pain (Banez & Steffen, 2001). In addition, while much of the research reviewed in this article has focused on using self-regulation skills to control or regulate the autonomic nervous system, there have been numerous attempts at applications of biofeedback to control and regulate more voluntary responses. For example, biofeedback has been used with children to treat functional voice disorders (e.g., Allen, Bernstein, & Chait, 1991; Watson, Allen, & Allen, 1993), improve sphincter control associated with urinary dysfunctional voiding (Duel, 2003), and fecal incontinence (Heymen, Jones, Ringel, Scarlett, 2001), and to increase the amplitude of respiratory sinus arrhythmia in children with asthma (Lehrer, Smetankin, & Potapova, 2000). In addition, there are promising new areas of applications with children, including postural training for idiopathic scoliosis (e.g., Wong, Mak, Luk, Evans, & Brown, 2001), and neurofeedback for ADHD (Rossiter, 2004). While none of these applications have the vast research support of thermal biofeedback as a treatment for recurrent headache in children, these are all promising areas of inquiry. As those of us in pediatric behavioral medicine become increasingly cognizant of the interactive role of stress, life-style, habits, and environmental variables in the development, maintenance, and treatment of many health-related concerns, it is only logical that the potential applications for behavioral interventions will expand.

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